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NEW RAW MATERIALS, PRODUCTION METHODS, AND PRODUCTS IN THE USSR CONSTRUCTION MATERIALS INDUSTRY

/Numbers in parentheses refer to appended sources./

Introduction

To cope more adequately with the problems confronting the construction materials industry in the USSR, a large number of experiments has been carried out. These have been concerned with discovering new sources of raw materials and improved production methods which can be readily adopted to replace or supplement materials and methods already available and which will aid in reducing the expenditure of time and money and provide improved-quality products.

The emphasis has been on the adaptation of local raw materials and, when possible, of materials heretofore considered waste or unsuitable for use in construction, such as cinders, poor-grade sand and clay, rock, and the like. In production, the effort has been directed toward a comprehensive streamlining of individual plant production processes. This has resulted in the complete or partial mechanization of a number of enterprises throughout the USSR. The Lipkany Industrial Combine, for example, completed the complex mechanization of its enterprise by the end of August 1951 and now produces roof tiles only by mechanized methods.(1)

Another phase of this effort has been the adoption of standardization. Thus, the problem created by the necessity of producing several hundred different types of tiles and blocks and which complicated and increased the cost of production has been solved at the Kudinov Ceramic Block Plant by the production of eight st ndard types of tiles which can be successfully used in the facing of any structure.(2)

A concerted effort is under way in the construction materials industry by criticism, exhortation, and praise to maintain and raise still further the output of the various enterprises of the industry.

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New Raw Materials for Construction Materials Production

Shale-Cinder Binding Material

Large interest has been manifested in the Estonian SSR concerning the use of shale-cinder binding materials as a substitute for Portland cement in view of the existing deficiency of construction materials. Such a change would ha[ve] great significance in the national economy in that it would involve the utilization of a basic mineral, namely, combustible shale.

The Institute of Construction and Architecture of the Academy of Sciences Estonian SSR, together with the "Kvarts" and "Silikat" silicate brick plants, is carrying on experimental work in connection with the production of cinder-sand bricks. An experimental consignment of the product has been prepared. Technological instructions for the production of cindersand brick under conditions adaptable to agricultural localities have been worked out.

Despite the efforts of the institute, little cooperation has been received from the various ministries of the republic responsible for full-scale production of the product.

No better cooperation has been received in another important series of experiments of the institute, namely, the utilization of cinders derived from the jet-flame combustion of pulverized shale. These cinders, ground and improved (especially by adding water), constitute a high-grade Roman cement. Such shale-cinder Roman cement can be substituted for Portland cement, of which there is a deficiency, as well as for lime. Roman cement is two or more times cheaper than lime and still more so than Portland cement.(3)

Experiments have shown that a method of grinding oil-shale cinders under plant conditions can yield a grade of hydraulic binding up to and including grade 150. Under laboratory conditions grade 300 of hydraulic binding was attained.

The oil-shale cinders are obtained from a furnace of the fire-grate type, as well as from a furnace which burns pulverized oil-shale and does not employ hydraulic ash removal.

The cinders obtained from the furnace of the fire-grate type can be used after being finely ground in mills. The grade of the ground cinders must satisfy GOST 2542-44.

From the furnace burning pulverized oil shale, the cinders may be used which pass completely through a sieve having 64 openings per one square centimeter.

All types of oil-shale cinders should be tested for uniformity of changes in volume.

One of the widest spheres of utilization of oil-shale cinders in construction is the manufacture of the above-mentioned oil-shale-sand bricks (measuring 250 x 120 x 65 millimeters) by a method of steaming. They can also be used in the production of solid or hollow building blocks of other dimensions.

The oil-shale-sand brick is divided according to strength into three grades--50, 75, and 100. In the table below are shown the dimensions of temporal strength for brick of different grades.

Temporal Resistance (kg/cu m)

Grade of Brick	In an Air-Dried Condition	After Testing Resistance to Frost
50	50/40	--
75	75/50	45
100	100/75	60

In the main, oil-shale cinder-sand brick is used for the laying of exterior and interior walls of living quarters, and administrative, industrial, and agricultural buildings up to three stories in height.

Oil-shale cinders are also used for the manufacture of plaster. In jobs involving exterior plastering, the introduction of oil-shale cinders makes it possible to reduce the expenditure of cement by half. For example, instead of a mixture with a solution having a composition 1 : 0.2 : 3 (cement : lime paste : sand) a mixture of 0.5 : 0.2 : 0.5 : 3 (cement : lime paste : oil-shale cinders : sand) is used.

For internal plastering, a mixture of 1 : 0.5 : 4.5 (oil-shale cinders : lime paste : sand) is used.

For the plastering of horizontal surfaces, the same mixture is used with the addition of gypsum in the amount of 0.3 part to one part of cinders.(4)

Crushed Shell-Rock

Experiments at the Kiev Technological Institute have resulted in the development of the production technology for self-hardening brick. The raw material for this process is ordinary, crushed shell rock, deposits of which are located in the Crimea, in the southern Ukraine, and particularly in Odessa, Izmail', Zaporozh'ye, and Kherson oblasts.

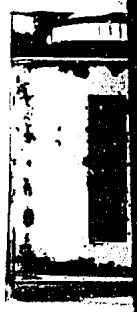
Heretofore, this kind of clay has been chiefly used only as ballast for the roadbeds of railroads. After long experiments, it was discovered that finely pulverized shell-rock, mixed with a small quantity of lime and water, solidifies and is converted into fairly hard stone. Exposed to air after pressing, the brick, in the course of a 5-10-day period, is changed and becomes ready for construction. This brick is water resistant and in quality surpasses the shell rock.(5)

Fine-Grained Karakum Sand

A method of producing silicate brick from fine-grained Karakum sand has been worked out at the Institute of Antiseismic Construction. An experimental batch of the brick possessed high-quality strength and met all GOST requirements. The possibility of constructing plants in Ashkhabad and along the route of the Main Turkmen Canal for the production of this material has now developed.(6)

Production Waste Products: Coal Clinkers and Cinders

A new construction material, "Penoshlak" which is manufactured from the waste products of production, namely, coal clinkers and cinders, has been developed. The clinkers and cinders are subjected to special treatment and yield a product which is six to seven times lighter than brick. Products made from "Penoshlak" possess great strength and high heat resistance. Use of the new material instead of brick lowers the cost of wall construction by 36 percent.(7)



Metal Waste

During the current year, the Artashatskiy Rayon Industrial Combine in the Armenian SSR has engaged in the large-scale production of metal tiles from the steel waste of the Yerevan Electric Machine Construction Plant.

The metal tiles are used for the covering of roofs of both industrial enterprises and homes on the kolkhozes. They are an improvement by reason of their great strength and convenience in use. By the end of the year, the combine will have produced 250,000 of these tiles.(8)

Low-Quality Clay, Sand, and Other Materials

The Kiev Technological Institute has developed a technique of producing unkilned brick from low-quality clay, sand, and other materials. Dry and finely-pulverized clay or sand are mixed with a little lime, moistened, and then formed in an ordinary brick press.

Laboratory experiments show that in hardness, the unkilned brick compares favorably with kilned and in certain cases even surpasses it. It is water resistant and long lasting. Thus, the brick can be successfully used in multistoried living dwellings.(5)

New Type Construction Materials

Experimental Production of Large Panel Blocks

At the end of 1951, at the Pavlovsk Silicate Brick Plant in Leningrad, an experimental consignment of large silicate building blocks was produced.

The blocks were manufactured in the following manner: detachable, rectangular forms were set on the trolley, and filled with a prepared silicate composition. A lump of burnt lime was first ground up in a ball mill and then, together with added sand, kept in the storage section of the plant. Before being put into the forms, the silicate composition was moistened with water, which constituted from 9 to 11 percent of the total. Then, a fine, moistened filler composed of silicate brick facing or slag clinkers was added to the solution so that the total quantity of water in the mixture did not exceed 16-18 percent.

The mixed composition was divided among the forms and compressed to assure filling in the corners. The surface of the block was leveled off next, and the forms were laid on the trolleys and placed in autoclaves for steaming. The steaming was carried on in the boiler in the same manner as employed in the production of silicate brick. From each finished lot, three blocks were selected for laboratory check. The mechanical strength of these blocks was determined by testing small blocks in the laboratory.

In addition, the blocks were tested for water absorbability. All tests were carried out on the fifth day after steaming. The results of testing the blocks prepared from the silicate composition with the added filler (with the moistening of the composition up to 16 percent) are shown below.

Block	Dimensions of Stone (cm) Length	Width	Height	Volumetric Weight (ton/cm m)	Water Absorbability (percent)	Strength Capacity During Contraction	Remarks
No 1	40.6	20.3	19.9	1.67	8.9	134.5	Test after 5 days
No 2	40.0	20.5	20.7	1.70	8.1	129.6	
No 3	40.2	20.4	19.8	1.60	10.1	112.3	

The water absorbability of the blocks was found to be less than that of silicate brick, and the strength of the blocks was greater by approximately 67.5 percent.

Silicate brick which is exposed to air after steaming for 15-30 days, possesses a greater strength than brick which has just been unloaded from the autoclave. This is explained by the fact that in the drying of the brick, calcium hydrosilicate is formed, giving a strong crystalline adhesion which is weakened by the presence of the excess not acted on by the water. In addition, the carbon dioxide of the air gradually carbonizes the free filler which did not combine with the silicon dioxide of the lime.

The use of large silicate blocks in construction obviates the necessity for containers, reduces the time required for erecting walls, reduces the amount of mortar for laying walks, and also decreases the width of walls in comparison with the brick walls in view of the decrease of the volumetric weight of hollow blocks up to 1,200-1,400 kilogram/per cubic meter.

The manufacture of large silicate panel blocks at the plant also has the advantage of excluding from the technological process the necessity for pressing, which is required in the production of brick; this makes possible a saving of electric energy.

Furthermore, it is possible to treat the material without a damping drum. The slaking of the ground lime at the moment the sand and the lime are mixed in the crusher rolls does not impair the quality of the blocks, since the silicate composition, having a pouring consistency and having been put into metal forms, permits the shaping of blocks of required measurements, form, and strength.(4)

New Large Building Blocks

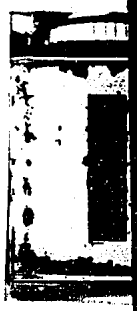
The erection of stone construction at building areas by a method of piecemeal brick-laying is being retained from among several construction processes which did not conform to the principles of the industrialization of construction.

In substance, the proposed method is as follows: at the brick plants or at the places where brick-manufacture is being carried on, stacks of wall blocks are laid out, weighing half a ton or more, depending on the lifting capacity of the crane. The large building blocks are transported from the factories to the building area, where they are used for construction of walls.

The manufacture of large brick blocks is accomplished with the aid of forms, the use of which relieves the bricklayer of the task of verifying the plan measurements for laying walls, tightening the bracing, the use of guide bars, checking corners with a plumb line, and other operations in which he loses more than half his time. Moreover, through the use of forms, it is possible to produce large blocks of very complex shape. By this means, the productivity of labor is increased more than five times over ordinary bricklaying. The forms are made of wood. The form itself consists of a four-cornered frame with notches one centimeter in width at intervals of 7.5 centimeter. Wooden pins are placed in the notches on which the guide-bar frame rests. The guide-bar frame itself is 6.5 centimeter in height. This method permits the preparation of a block of any shape through the use of a single form.

The forms may be made not only from wood but also from steel; in the latter case, the quality of the manufactured blocks is better.

The building block has a one-quarter projection on two sides. Thus, when the blocks are joined, this permits the creation of a groove which is overlapped by one-quarter or one-half brick and thereby completely guarantees the wall as holeproof.



In the process of manufacture of the large blocks, it is possible to plaster simultaneously, thereby greatly reducing the number of wet processes.

The large blocks can be utilized for the following construction: (1) continuous cross section with chain and multiple system of bond; and (2) the easier construction with one-sided or two-sided facing in half or quarter brick with various fillers from local materials.

The large brick blocks can be manufactured without the use of cement. The mortar is replaced by a silicate composition, and the block is processed in an autoclave.

Experiments conducted at the Stalingrad Silicate Plant No 4 have confirmed the expediency of the manufacture of large blocks on the basis of the existing technology for the manufacture of silicate brick. However, it requires only one operation: instead of packing the brick clay in the trolley with provision for space between rows (since this is usually done so that the individual bricks will not stick to one another after steaming), the packing of the bricks is made up into large blocks without leaving spaces and even with the addition of a small layer of solution from this same silicate mass.

The effect of the steaming is to acquire a high strength for the solution, attaining grade 100, with a very high degree of cohesion (4 kilogram per square centimeter), thanks to which the solidity of the block permits its transport by any kind of transportation. The planned grades of the solutions during the preparation of the large blocks, from finished silicate brick to the solutions from the silicate compositon, acquire strength even after packing them for 2 hours in the autoclaves.

It is also possible to produce a large, light-duty type block from silicate brick; in this, only the facing, prepared from finished brick 20-25 percent in volume, goes through the steaming twice, but the filler from the silicate composition, comprising up to 80 percent, is steamed one and is not subjected to the pressing.

In the process of the production of large blocks, according to this technology, it is possible to apply to the surface of the block a layer of 2-3 millimeter of solution prepared from the same silicate mixture; the latter, after the steaming, has the best cohesion with the body of the block.(4)

Gas Silicate

The Central Scientific Research Laboratory of the Ministry of Construction Materials Industry Latvian SSR, in conjunction with the Riga "Rigips" Plant, has developed a product known as gas silicate, a new construction material which will be widely used in the construction of interstory ceilings, as heat insulation, and so on.

Gas silicate will completely replace so-called foam silicate, over which it holds several advantages. It possesses a small [illegible] weight, low heat conductivity, and adequate strength. The method of its production is simple; it does not require such hard-to-get chemicals as calcined lime, not the additional equipment required for the production of foamsilicate.(9)

Coarsely Porous Cement

At Silikatnaya station on the Moscow-Kursk Railroad, the construction of two experimental homes has been completed. Their walls have been built from a new construction material, namely, coarsely porous cement, which was perfected in the laboratory of the Scientific Research Cement Institute.

The coarsely porous concrete was prepared from crushed rock, limestone, and dolomite. It is a durable and inexpensive building material; a cubic meter of it is twice as cheap as a cubic meter of laid brick.(10)

Mineralized Slabs

In the laboratory of the All-Union Office of "Termoproyekt" there has been prepared a new heat-resistant material--mineralized slabs, intended for the insulation of exterior walls of structures. They make it possible to decrease the thickness of the walls of multistoried buildings and significantly to decrease the expenditure of brick.(10)

New-Type Hydrophobic Cement

In the search for more economical, effective, and longer-lasting building materials, the construction materials laboratory of the Institute of Construction, Academy of Sciences Uzbek SSR, has produced a new type of hydrophobic cement.

Hydrophobic cements differ from ordinary silicate cements in a series of special characteristics, according to their relationship to water, which improves the physicomechanical characteristics of mortars and concretes. Among these special characteristics of hydrophobic cement is its hygroscopicity, that is, its capacity for resisting moisture. This permits the cement to be stored for a longer time. The hydrophobic cement, produced under laboratory conditions and lying in a damp room for 2 years, did not crumple and retained its friability completely. During this time, the activity of the cement was reduced by only seven percent. The control sample of ordinary cement during the 2-year period completely crumpled and lost more than 70 percent of its activity.

With an equal amount of cement and water and with an equal filler of hydrophobic cement, more pliable mortars and concrete mixtures are obtained. Under certain conditions, this results in a large saving of cement. Furthermore, since a simultaneous hydrophobic obstruction and an intake of air occurs, the output of production is increased 5-12 percent.

The hydrophobic cement in the mixtures also possesses an increased water-retentive capacity. This is of special value in the climatic conditions of Uzbekistan, particularly in the zone of the Main Turkmen Canal, because it permits an increase in the distance that concrete mixture can be transported. In the hardening of cement prepared from hydrophobic cement, the capillary rise of water is completely stopped. This permits it to be widely used in construction for the water-proofing of foundations instead of roof water-proofing, which is prohibited in regions subject to earthquakes.

Hydrophobic cement sharply increases the frost and water resistance of mortar and concrete. Mortar and concrete prepared from hydrophobic cement are unsurpassed in strength by ordinary cement.

Any cement plant of the republic can be converted to the production of hydrophobic cement without complicating its technology. Construction organizations are also interested in this production. The new type of cement will make possible an increase in the quality of manufactured products and will be of great benefit to construction.(11)

New-Type Concrete

Facts about a new type of concrete were presented in a lecture at the Permanent All-Union Construction Exhibit. This product is created by the addition of slaked lime and hydrochloric acid. The lime quickly dissolves in the hydrochloric acid, which activates the cement grains and the surface of the filler. During the mixing, the hydrochloric acid, which has been added to the water, causes a spontaneous heating of the concrete and thereby aids in its rapid hardening under winter conditions.(12)

Colored Asphalt

Experiments have been carried out in the use of colored asphalt on various streets, squares, and bridges of Moscow and other cities of the USSR. For example, blue and rose asphalt were used on the square on Neglinnaya Ulitsa. Laboratory tests on the new road-construction material have been completed and workers have discovered methods of preparing asphalt of all colors. It is of the same quality as ordinary asphalt and is being widely used for decorative purposes. It is planned to put colored asphalt into full-scale production.(13)

New Ceramic Tiles

The Central Scientific Research Laboratory of the Ministry of Construction Materials Industry Latvian SSR has completed work on a new durable and beautiful construction material namely, ceramic tiles for carpet mosaics. These tiles were produced from local thuyan clay and are used for flooring in vestibules and shops. The first consignment is being produced by the Riga Dutch Tile Plant and the Bolderaye Ceramics Plant.(14)

New Construction Materials: Miscellaneous

Great interest has been shown in ceramic products manufactured by the Kiev Experimental Plant, Ministry of Construction Materials Industry Ukrainian SSR, which consist of hollow blocks for sills, framing for window apertures, facing tiles, and artistic bas-relief insert for such framing.

Odessa has produced tiles of thin iron. In this type of roofing material, lightness is combined with strength; iron tile lasts several times longer than iron sheeting and does not require painting.

Yerevan has produced multicolored cement which has been successfully used for exterior finishing of buildings.

The Leningrad Paper Mill No 1 has produced wood-fiber tiles of various types which serve as heat-resistant material and are used to replace dry plaster. Special superhard tiles are used as high-quality parquette in the laying of floors.(15)

New Construction Material Production Methods

Improved Method of Charging Brick

An effective method of charging the clay of bricks for kilning in annular furnaces has been developed at the Ivanovo Brick Plant No 4. The bricks are laid on edge along a channel under a small quantity of coal. This produces a so-called herringbone effect. It eliminates breakage on the bottom levels, and the volume of brick per cubic meter of furnace is thereby increased by 10-15 bricks. Fuel is uniformly distributed among the brick and burning is hastened.

This method permits the kilning of brick of higher moisturecontent and improves the quality of the finished product. The production cycle has been reduced from 4½ or 5 twenty-four hour periods to three such periods. A total of 1,900 instead of 1,200 bricks per cubic meter of furnace can now be charged each day.

The new method is being employed throughout the Latvian SSR.(16)

New Method of Plasterboard Production

The Frunze Construction Components Plant is searching for new reserves for reducing the cost of production.

The architectural-plastic shop has begun the production of lightweight plasterboard slabs and architectural components and is employing a new method. Into the gypsum 40 percent production waste, such as sawdust or shavings is mixed. As a result of this, the quality is not only not decreased but actually improved. Much gypsum is saved thereby and the product is reduced in weight The use of plasterboard sheets results in a saving of 12 percent of wood materials.

The architectural-plastic shop is beginning the mass processing of cornices from plasterboard sheets. In the exterior facing and in the covering of ceilings of new structures, it is intended to manufacture only these products.(17)

Experimental Method of Wet Dust Elimination From Waste Gases

An experimental method of wet elimination of dust from waste gases of rotating furnaces has been set up at the "Gigant" Cement Plant. A test of one of the furnaces has shown the wet dust elimination of waste gases to give good results.

In many cement plants, together with the waste gases, a large quantity of brick-clay composition has been carried off into the atmosphere. Now, a sure method of avoiding the loss of this dust has been discovered. In essense, it is as follows: sprayers have been fixed at a certain height in the flue. When water is passed through them, falling on the walls of the flue, it carries off with it the dust contained in the flue gases. The arrangement for the wet dust elimination from waste gases was put in operation on 11 June. Every hour, it recovered 3-4 tons of brick clay. During this period, it used up 15-17 cubic meters of water. This water and the collected dust produced a hot sludge with a temperature of 60-65 degrees centigrade and a moisture-content of 75-80 percent. This sludge flows into a brick-clay grinder through a special pipe.(18)

Improved Method of Glazed Facing-Block Production

The production of glazed facing blocks has been introduced at the Tashkent Ceramics Plant of the Ministry of Railroads USSR. There has been designed and constructed a 60-channel conduit furnace in which the burning process is carried on continuously; this increases the utilization of waste gases. The time consumed in burning in the new technique is 12 hours instead of the 70 hours of the old process. The labor cost has been decreased sixfold.

The products of the Tashkent Ceramics Plant are being shipped to Moscow, Khar'kov, Tbilisi, and to the cities of Central Asia and Kazakhstan. There is a great demand for facing blocks for the construction in Tashkent.(19)

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